G40 The Role of Hyponatremia in Fresh Water Drowning and Water Intoxication: Making the Distinction at Autopsy

Kenneth S. Snell, MD Medical Examiner, Mecklenburg County Medical Examiner's Office, Charlotte, NC; Keith C. Kocis, MD, MS, Associate Professor of Pediatrics, Department of Pediatrics, University of North Carolina at Chapel Hill, Chapel Hill, NC; and Deborah L. Radisch, MD, MPH, Associate State Medical Examiner, Office of the Chief Medical Examiner, Chapel Hill, NC*

The goals of this presentation are to educate the forensic community to the role of hyponatremia in both drowning and water intoxication.

Drowning is defined as death following an episode of submersion. Water intoxication is defined as the intake of a sufficient quantity of fluid to cause symptomatic hyponatremia. The role of hyponatremia in both conditions will be reviewed. The case of a 4-year-old boy that drowned and his twin brother that survived the incident will be presented. At initial exam, both boys were unresponsive and documented to have hyponatremia; however, no seizure activity or cerebral edema was documented. The theory of acute water intoxication has been proposed as an alternative explanation for the events surrounding the incident.

Numerous studies have evaluated the role of serum electrolytes in the mechanism of death in drowning deaths. Serum sodium levels routinely remain above 126 mEq/L; however, approximately 12% of the cases will have serum sodium levels below 120 mEq/L. The hyponatremia is a consequence of absorption of aspirated hypotonic fluid, which has been calculated to be less than 22 ml/kg in 85% of drowning deaths. The hyponatremia associated with fluid aspiration resolves without medical intervention and is not considered a life-threatening anomaly. Therefore, hyponatremia is not associated with the mechanism of death in drowning.

Acute water intoxication occurs over a short period during which the individual consumes sufficient quantities of low sodium-containing fluids to cause symptomatic hyponatremia. The hyponatremia does not spontaneously resolve and results in prolonged seizure activity secondary to cerebral edema. In three cases that resulted in death, children from 6 to 16 years old were forced to consume between 3 and 6 liters of water at one time as punishment. The volumes retained averaged 41 ml/kg/hour and the serum sodium ranged from 109 to 114 mEq/L. All three children developed seizures, and cerebral edema was noted at autopsy. The literature has numerous reports of infants less than 1-year-old that developed acute water intoxication during swimming lessons. Serum sodium levels ranged from 111 to 123 mEq/L and seizure activity was documented in all cases. All of these infants recovered with medical therapy aimed at treating the hyponatremia. A single case of acute water intoxication occurring in a 12-year-old boy lodged in a drainpipe of a swimming pool has been documented. After a complete recovery from a serum sodium level of 111 mEq/L, the boy recalled swallowing large quantities of water.

In conclusion, fresh water drowning is not routinely associated with hyponatremia, but a small percentage of cases do have documented hyponatremia. Acute water intoxication is associated with symptomatic hyponatremia and requires diagnosis-directed therapy. Most of these cases have been documented in infants undergoing swimming lessons or in child abuse cases.

Hyponatremia, Drowning, Acute Water Intoxication

 ** Presenting Author*